Sensing Harmful Gases in Industries using IOT and WSN

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***Abstract*—Industrial automation has become very much popular these days because of upcoming demand in the competitive scenario. This project proposed a secured and energy efficient wireless industrial automation system via IOT and WSN technology. In this system small scale industrial sensing applications like temperature control, proximity sensing, humidity monitoring etc. can monitor wirelessly through wireless devices. The small, rugged, inexpensive and low powered WSN node consisting sensors and ARM-7 will bring the IoT to even the smallest objects installed in any kind of environment, at reasonable costs. Raspberry-Pi module is used as IOT gateway. IoT is used for transmission and reception of data. Using web server along with raspberry pi it is possible to monitor and control industrial devices remotely by using local internet browser and the data can be displayed on dashboard for further controlling actions. Use of these both IOT and WSN technology reduces complexibility of devices and also reduces overall cost of the system.**

***Keywords*—Industrial Automation, IOT, WSN, gas sensors, Harmful gases, Raspberry-Pi**

I. Introduction

Industrial gases are gaseous materials that are emitted out from Industries. The principal gases are nitrogen, oxygen, carbon dioxide, argon, hydrogen, helium and acetylene; although a huge variety of gases and mixtures are available in gas cylinders. Industrial gases are emitted due to manufacturing of various items and materials that are used in a wide applications Industrial gases are very harmful and have severe impact on anyone or anything exposed to it. In industry there are many workers working in various units like production, packaging, building, manufacturing etc they are some or the other way exposed to these harmful gases which affects them very badly and sometimes even may cause death. This Industrial business also covers the sale or hire of gas cylinders and associated equipment to tradesmen and occasionally the general public. Products such as helium-balloons, dispensing gases, welding gases , LPG and medical oxygen-emission also though used widely for some application are harmful .

Currently IIoT i.e. Industrial Internet of Things is widely regarded as to be one of the latest developing trends affecting industrial businesses today and also in the upcoming future. Industries are upgrading to modernize technologies and systems to meet new regulations, to keep up with increasing market speed and volatility, and to deal with developing technologies.Significant improvements to safety, efficiency, and profitability etc had been marked for Industries that had IIoT implemented and it is expected that this trend will continue as IIoT technologies are more widely adopted.

Spatially distributed and dedicated sensors which works collectively as a network or collect and process data of cluster is known as Wireless Sensor Nodes(WSN).IT monitors and record the physical conditions of the environment and organized the collected data at a central location. WSNs measures environmental conditions like pollution levels, humidity, temperature, sound, wind, and so on. The WSN is built of nodes which are placed in a network and can be from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. The internal circuitry of each such sensor network nodes typically has several parts: micro-controller which controls the processing of node, a radio transceiver with an internal antenna or connection to an external antenna which is usually used for communicating purpose, an electronic circuit for interfacing with the other sensors and an energy source usually a battery or an embedded form of energy harvesting that provide energy to every circuit in the node. Size of a sensor node might vary for every application its being used, although functioning ”motes” of genuine microscopic dimensions are yet to be created. Similarly the cost of sensor nodes is variable, ranging from a few to hundreds of dollars, depending upon the complexity of the individual sensor nodes..As the size and cost of the sensor nodes varies likewise other resources like computational speed,energy,communication bandwidth,memory etc may also vary to a greater extent.

II. Literature Survey

In paper Distributed System as Internet of Things for a new low cost, Air Pollution Wireless Monitoring on Real Time the author has described A low-cost wireless monitoring system is developed to measure CO, CO2 and the density of dust parameters based on a multi-layer distributed model with an Arduino platform, sensors and wireless connectivity Xbee. The data is collected in computer and send to web page to monitor air pollution on real-time. The validation of the mentioned

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concept has been realized in cities Quito, Amaguaña and Tena of Ecuador. The system is quite complex since they have used various types of software languages for various purposes (For ex. Java for computer system, C/C++ for conversion of analog data to digital form, etc).[1] In IOT- Based Air Pollution Monitoring and Forecasting System the author explained IOT based air pollution monitoring and forecasting system [2] consist of a system where environmental sensors including SO2, NO2, CO sensors and Meteorological sensors (wind direction, wind speed, temperature, humidity and air pressure) are installed in some of the monitoring points. The system can be laid out in a large number in monitoring area to form monitoring sensor network. It also exhibits the function of forecasting by analyzing the obtained data neural network technology. The WSN based air pollution monitoring system [3] its developed on AVR AT-mega-32 Micro-controller as controlling unit of overall system. Data-set of different sensors parameters like MQ5,MQ7,Temperature and Humidity is detected by the Sensor Grid used.ID3 algorithm is used to calculate the values base on probability. Bluetooth module is used to connect the controller with client and the client connects with the server via web services. This system not only calculates the pollutants present in the air but also can make a forecast to avoid future pollution in the particular polluted area. Here they consider mainly the chemical Industry near Pune and the I.T. area like Hinjewadi. The author describes Zigbee and GPS based air pollution monitoring system [6] various sensors are interface to the system to measure the mostly detectable air pollutants such as SO2, CO, NO2 and NO etc. The measured data is displayed on the monitor using the graphical user interface (GUI). The pollutants level is stored on data based server and interfaced to Google maps to display real time pollutants, pollutants level and locations in large areas. It uses a low power wireless sensor network also the pollution level and location is displayed graphically using Google maps. The real time monitoring system [8] has used sensors for sensing concentration of gases like CO2, NO2, CO and O2. For basic wireless communication module Libelium WASP motes were used, it comprises of the the communication unit and processing unit. The collected samples are packetized and sent to base station.To view this pollution data in the form of numbers and charts was developed and made available from anywhere on the internet a web interfacer is used.Libelium WASP motes is too costly. This system consumes lot of energy from batteries. The designed air pollution monitoring system in [7] was implemented and tested using the wireless sensor network. Pollutant gases such as CO2, NO2, and SO2 are collected from environment. The various mobile sensor arrays collects pollution data which is then transmitted to a central serve that make this data available to government authority.The pollutant levels data is showed and also their performances to local air quality standards. The system uses the AQI to evaluate the level of health concern for a specific area. An air pollution monitoring system which is a small, portable and low-cost,the author has named as Adu-Air[5]. The ArduAir is used to monitor Carbon Monoxide concentration of an area and collected the data for the same. The sensor based system can also be used for various other gases such as SO2, NO2, CO2, O3, etc. using different sensors. The general public can use this system effectively for monitoring the quality of air around them. A large scale installation of this system is possible and can be used domestically by a large number of people. The real time indoor CO2 system [4] aims to monitor and detect the concentration of CO2 in a real-time basis. It uses IAQ 2000 sensor for CO2 detection. Radio modules used for transferring the data to control room. In control room all data is processed and using GUI it is plotted on graph. It provides overall air quality alerts time to time.

III. Proposed Methodology

The proposed work shall utilize IOT and WSN technology to achieve better connectivity and to create good sensing area. Switching actions shall be incorporated in order to achieve multiple observations of the different sensors used. Different harmful gases CO2,NH3,Benzene,Sulphur Dioxide,Nitrogen oxide,Carbon Monoxide etc. shall be taken into consideration for obtaining optimized data for visualization. Raspberry-Pi software C.net along with Zigbee module will be used to design IOT gateway. Further simulation results will be observed and compared using graphical representation on dashboards.

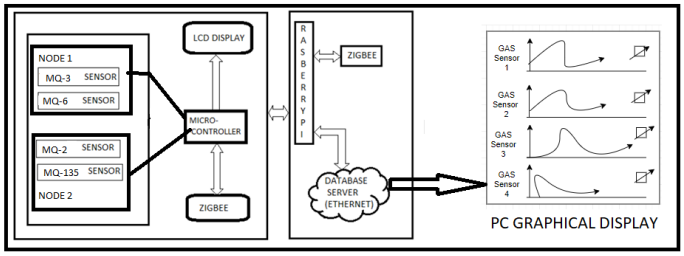

Fig. 1. Block Diagram

To sensed various harmful gases present in industrial area, then visualized it on dashboard for taking proper decision to control its contamination in the industrial area so as to ensure healthy working environment for employees working in industry. Also to make the overall system cost effective and efficient. In the proposed work, both software and hardware part are included in such a manner that IOT and WSN technology when clubbed with reconfigurability concept will have observing responses throughout all the sensing duration. On pc VB.net will be used to visualized the graph harmful gases such as CO2, NH3, Benzene, Nitrogen oxide etc. Raspberry-Pi software C.net will be used as a IOT Gateway to transfer the sensed data through web-server to PC where the data can be visualized using dashboards controlling actions can be carried out. Further data can be stored in database using SQL Database.

IV. Experimental Results

Fig. 2. Output Screen

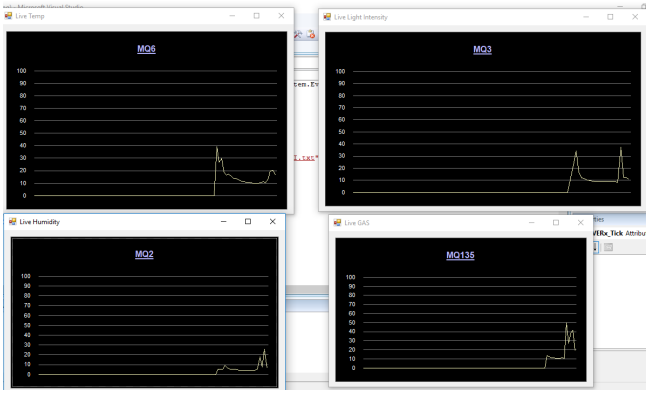

Fig. 3. Output Graphs

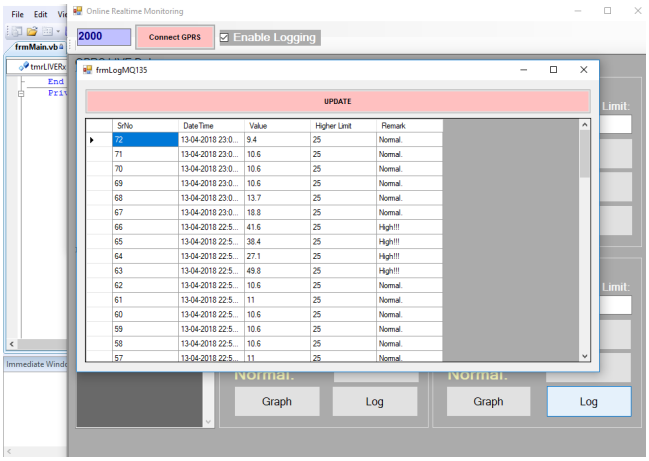

Fig. 4. Output Log

A. Experimental Results and Discussions

The output of this project is shown on the Output Screen since we are using four gas sensors MQ-6,MQ-3,MQ-2,MQ-135 so four graphs are displayed and also the data is logged using sql database.As the gas sensors will sensed the data the graphical representation and logging will be carried out simultaneously.On Output screen a highest value is pre-defined if the sensed data exceed this limit then manual buttons for ON/OFF is provided on screen.The incoming sensed data is calibrated and displayed in percentage from 0 to 100 percent. By observing the graphs and checking logged data the monitoring and controlling actions can be performed.

V. Conclusion and Future Work

This project is the integrates a Wireless Sensor Network (WSN)-based harmful gases sensing system using different gas sensors and whose sensed data is passed through IOT gateway to server.This system is very simple and integrated model as compared to the other existing air or gases quality monitoring systems.This project is also used for ensuring healthy atmosphere for the people who are mostly exposed to harmful gases. In future, this prototype can be extended since in this project X-bee is used which has limited range up to 100m so we can increased the distance by using X-bee Pro up-to km.Also we are using RPI whose application is restricted in internet based application only, so we can developed a hardware module which can work on mobile network.Thus we can enhanced the project .

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